Solar Ventilation Preheating

A Sun-Absorbing Wall Heats Ventilation Air for Buildings

Installing a "solar wall" to heat air before it enters a building, called solar ventilation preheating, is one of the most efficient ways of reducing energy costs using clean and renewable energy.

The system works by heating outside air with a south-facing solar collector—a dark-colored wall made of sheet metal and perforated with tiny holes. Outdoor air is drawn through the holes and heated as it absorbs the wall's warmth.

The warm air rises in the space between the solar wall and the building wall and is moved into the air-duct system, usually by means of a fan, to heat the building. Any additional heating needed at night or on cloudy days is supplied by the building's conventional heating system. During summer months, intake air bypasses the solar collector, preventing the air from being preheated.

A solar ventilation preheating system is approximately 75% efficient, losing only minimal heat to the surrounding air. In fact, it is the most efficient solar air-heating system available today. And, solar preheating systems can improve air circulation when used in conjunction with air delivery systems.

Using solar energy to preheat intake air for a building's ventilation system has numerous advantages:

- It reduces annual heating costs by $10–$30 per square meter ($1–$3 per square foot) of collector wall, depending on the type of fuel used, by preheating intake air by as much as 30°C (54°F).
- It requires almost no maintenance; there are no liquids and no moving parts other than the ventilation system fans.
- It can enhance a building's appearance even when added after the building is designed or built.

What are the opportunities?

Solar ventilation preheating systems are practical for many types of government buildings:

- Commercial and industrial buildings with large ventilation requirements
- Warehouses and other storage facilities, especially those that house materials requiring continuous ventilation (e.g., chemicals)
- Laboratory facilities
- Motorpools
- Gymnasiums and high-rise apartment buildings requiring ventilation in corridors
- Central-heating plants or industrial-size furnaces (e.g., to preheat combustion air).

Warren Gretz, NREL/PIX00594

This solar collector preheats ventilation air for a hanger at the Fort Carson Army Post near Colorado Springs, Colorado.

Ross Foltz/PIX02087

What is required?

A solar wall can be designed as an integral part of a new building or it can be added in a retrofit project. Expenses are minimal, because a solar collector doesn't require much mechanical equipment in addition to the heating, ventilation, and air-conditioning system, and because the perforated wall doesn't have to be covered with glass, unlike glazed, flat-plate solar collectors.

Several factors will determine whether solar ventilation preheating is a good choice for a facility:

- The price of conventional energy used for space heating: the higher the price of the conventional

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What are the important terms?

Makeup Air—the outside air drawn into the intake ducts of a ventilation system to be used for ventilating the space in a building.

Plenum—the space between the perforated metal wall and the main building wall.

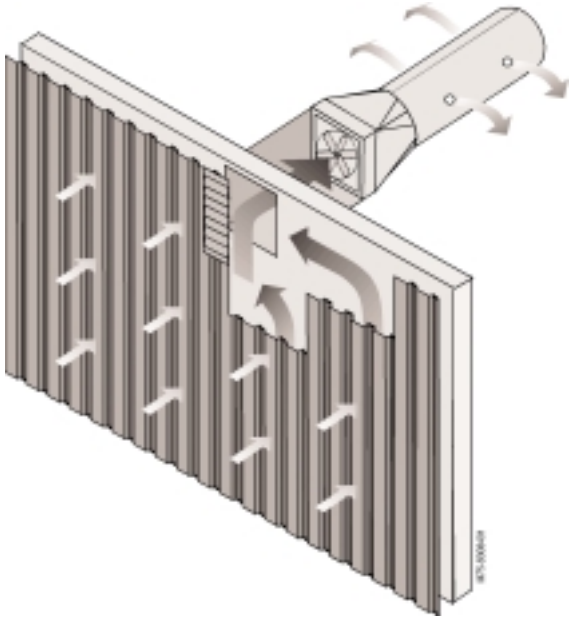
Stratification—a process that occurs when warm air rises and collects near the ceiling due to poor circulation of air.

Transpired—refers to the movement of air through the small holes in the solar wall. The perforated wall is also called a transpired solar collector.

Unglazed—refers to the absence of glass or plastic covering on the outside of the perforated wall.

energy, the more cost-effective the transpired collector application becomes.

- The length of the building's heating season: the building should have a relatively long heating season, because solar ventilation preheating works well in relatively cold and sunny climates.
- The size of south-facing wall: the wall must have enough surface area to mount the collector in an aesthetically pleasing way. A rule of thumb is that 1 square foot of collector area will heat 4 to 10 cubic feet of air per minute.



Transpired collector components

- The ventilation requirements of the building: a candidate building must have a minimum ventilation requirement, based on the building's size and on the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) Standard 62.
- Heating applications that benefit the most from solar ventilation preheating are typically those with relatively large outside-air ventilation loads (high makeup-air rates).

What does it cost?

The cost-effectiveness of this technology depends on the type of fuel used in the conventional heating system and on local utility costs. In some retrofits, the solar collector has paid for itself in as little as 6–7 years. In new construction projects, paybacks have been as brief as 3 years.

For More Information

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